YIELD AND ITS COMPONENTS IN CHICKPEA GENETIC VARIABILITY AND CORRELATION (*Cicer arietinum L.*)

DASTI SAI KISHORE & GABRIEL. M. LAL

Naini Agriculture Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture,

Technology and Sciences, Prayagraj, Uttar Pradesh, India

ABSTRACT

The substance used in the experiment was made of 20 chickpea genotypes. The experiment was set up in a three replication Randomized full Block Design. For 11 quantitative characters, observations were gathered on five randomly selected plants for each treatment and replication viz., All thegenotypes of chickpea showed significant differences among them, significance variability existed forall the characters. A high yield was discovered based on average performance for IPC-06127 [25.93] andICC-15855 [22.26].The number of primary branches per plant, secondary branches per plant, pods per plant, effective pods per plant, biological yield per plant, seed index, and seed yield per plant all had a high PCV and GCV.Number of major branches per plant, number of secondary branches per plant, number of pods per plant, number of effective pods per plant, biological yield per plant, seed index, and seed yield per plant all had significant heritability (>60%) and genetic progress (>20%). At both the genotypic and phenotypic levels, seed yield per plant was very significant and significantly linked with biological yield per plant, number of pods per plant, number of effective pods per plant, and plant height.

At the phenotypic level, path analysis revealed biological yield per plant, and the harvest index revealed a strong positive direct effect on seed yield per plant.

KEYWORDS: Chickpea, Heritability, Genetic Advancement, Genotypic Correlation, Phenotypic Correlation, & Path Analysis

Original Article

INTRODUCTION

Chickpea, also known as chana, Bengal gramme, gramme, kadle, and other names, is an ancient crop that dates back to before 10000 B.C. It was domesticated approximately 7500 B.C. in the regions of southeast Turkey and the ancient city of Jericho, and it has gained popularity since then. Chickpea is grown in Turkey's central and eastern Mediterranean areas throughout the winter, whereas it is grown in India's south and north states during the rabi season.

In 2019, the global output of chickpeas was 14 million tonnes, with India accounting for 70% of the total and Turkey serving as a secondary producer. With 13.9 million ha of planted area and 13.7 million tonnes of production, chickpea is the world's second-largest crop after beans. Chickpeas are grown on 9.3 million hectares in India, with a yield of 9.53 million tonnes and a productivity of 960 kg per hectare. The area of chickpea in Uttar Pradesh is 7.69 lakh hectares, with a production of 6.81 lakh tonnes and a productivity of 891 kg per hectare (IIPR 2018-19). Chickpea consumption is being studied for its ability to improve nutrition and alter chronic diseases.

Chickpea is a self-pollinated crop that belongs to the subfamily papilionoideae and family leguminacea. Its scientific name is Cicer areitineum L., and it has chromosomal number 2n=16. Chickpea has become the world's second most important food legume plant. It plays a critical role in satisfying the protein requirements of people in developing countries. Because people require protein for a balanced and appropriate diet, protein and vitamin-rich foods should take precedence in the human diet, particularly in areas where there is considerable income disparity.

Chickpea is a highly nutritious grain legume that is high in energy, protein, minerals, vitamins, fiber, and phytochemicals. It also has a number of medicinal properties, including increasing sperm count, curing menstrual and urinary problems, reducing blood sugar, and treating intestine issues in humans. It is an excellent source of fodder for animals, and it also compensates for the lack of protein in cereal diets.**(JeenaandArora,2001&Geethanjali,2018)**.

Because it allows for the selection of preferred plant kinds, genetic variety is the most significant factor for any agricultural improvement programme. It aids in the hybridization or selection of higher-yielding yield attributes. The variance analysis uses estimates of phenotypes, genotypes, and environmental variances to calculate the corresponding coefficients of variation. The relative values of such variation coefficients reveal the degree of variety in a population. The phenotypic coefficient of variation, genotypic coefficient of variation, genetic progress, and heritability all play a role in extracting superior chickpea genotypes.

Estimates of heritability and genetic progress have been discovered to be important characteristics for selecting preferred plants. Heritability is a quantitative assessment that correlates genotypic variance to phenotypic variance, whereas genetic progress represents the population's genetic architecture.

The primary goal of measuring phenotypic, genotypic, and environmental correlations between yield and its components is to develop plant selection criteria. The amplitude and direction of the link suggest future improvements in the attributes under question.

Based on the concept of mutual interactions between yield features, path coefficient analysis divides correlation coefficients into direct and indirect impacts for distinct yield components. It's the standardised partial-regression coefficient derived from equations in which the yield attributes are given as standard deviations from the mean.**(SteelandTorrie,1982)**.

MATERIALS AND METHODS

During Rabi-2020-2021, the current study was conducted at the Field Experimentation Centre of the Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP).

The experimental materials, which included 20 genotypes and one check variety, were grown in three replications using Randomized Block Design (RBD). The experimental field was divided into three equal-sized blocks, each with a single genotype.

S.no	Genotypes
1.	IPC-06127
2.	RSG-945
3.	ICC-15928
4.	JBT-34166
5.	ICC-15683
6.	ICC-15926
7.	ICC-15226
8.	IPC-0559
9.	ICC-17007
10.	ICC-7549
11.	BKG-21204
12.	ICC-15921
13.	PUSA-362
14.	ICC-6020
15.	BKG-26212
16.	GPK-1058
17.	ICC-15855
18.	ICC-6117
19.	ADBG-375
20.	IG-7

RESULTS AND DISCUSSION

Genotypic Coefficient of Variation

Genotypic coefficient of variation varied from 2.230 for days to maturity to 33.633fornumberofpods perplant (33.633), number of effective pods per plant (32.041), biological yield per plant (28.247), number of secondary branches per plant (27.190), seed index (26.043), number of primary branches per plant (25.667), and seed yield per plant all had large genotypic coefficients of variation (23.192). Harvest index (14.987) and plant height (11.232) had moderate genotypic coefficients of variation, but days to 50% blooming (2.733) and days to maturity (11.232) had low genotypic coefficients of variation (2.230).

Phenotypic Coefficient of Variation

Days to maturity had a phenotypic coefficient of variation of 3.942, whereas the number of pods per plant had a phenotypic coefficient of variance of 34.807. Number of pods per plant (34.807), number of effective pods per plant (33.019), biological yield per plant (30.387), number of secondary branches per plant (27.663), seed index (26.936), number of primary branches per plant (26.211), and seed yield per plant (26.210) all had large phenotypic coefficients of variation(20.666). Plant height (12.998) had amoderate genotypic coefficient of variation,whereas days to50% blooming (6.270) and days to maturity (6.270) had low genotypic coefficients of variation (3.942).

HERITABILITY

Estimates of heritability ranged from 19.000 days to 50% flowering to the amount of secondary branches per plant (96.600). Number of secondary branches per plant (96.600), number of primary branches per plant (95.900), number of effective pods per plant (94.200), seed index (93.500), biological yield per plant (86.400), seed yield per plant (78.300), and plant height (74.700) had high heritability estimates, while harvest index (52.600) and days to maturity had moderate heritability estimates (32.000). Estimates of poor heritability for days to 50% flowering have been documented (19.000).

GENETIC ADVANCE

The number of major branches per plant ranged from 1.494 to 1.494 for the number of pods per plant (47.065). Number of pods per plant (47.065), number of effective pods per plant (38.123), and biological yield per plant (19.637), plant height (14.259), and harvest index (11.023) showed high genetic advance, while seed index (9.957), seed yield per plant (7.286), days to maturity (3.200), number of secondary branches per plant (2.176), days to 50% flowering (2.031), and number of primary branches per plant showed low genetic advance (1.494).

As a Percentage of the Mean, Genetic Progress

The genetic advance as a percentage of the mean ranged from 2.454 days to 50% flowering to 66.946 pods per plant. Number of pods per plant (66.946), number of effective pods per plant (64.048), number of secondary branches per plant (55.056), biological yield per plant (54.091), seed index (51.870), number of primary branches per plant (51.778), seed yield per plant (42.274), and harvest index all had a high magnitude of genetic advance as a percentage of the mean (22.389). Plant height (19.995) had moderate genetic advance as a percent of the mean, whereas days to maturity (2.594) and days to 50% blooming had poor genetic advance (2.454).

Correlation Coefficient Analysis

Phenotypic Correlation Coefficient Seed Yield Perplant

The number of secondary branches per plant (0.890**), biological yield per plant (0.655**), number of effective pods per plant (0.614**), number of pods per plant (0.614**), and plant height (0.348**) all had extremely significant positive correlations at the phenotypic level. It had a nonsignificant positive connection with the harvest index (0.1930), seed index (0.1595), number of primary branches per plant (0.0868), days to maturity (0.2449), and days to 50% flowering (0.2449).

Genotypic Correlation Coefficient Analysis Seed yield Perplant

At the genotypic level, seed yield per plant (0.795**), number of pods per plant (0.698**), number of effective pods per plant (0.695**), plant height (0.499**), days to 50% blooming (0.468**), and days to maturity (0.451**) all exhibited a highly significant positive connection. The number of secondary branches per plant (0.496), seed index (0.2043), and the number of primary branches per plant all revealed a non-significant positive connection (0.1054). It had a non-significant inverse relationship with the harvest index (-0.0937).

Pathco Efficient Analysis

Phenotypic Level

At the phenotypic level, path analysis revealed a strong positive direct effect for biological yield per plant (0.8826), harvest index (0.7680), and a moderate positive direct effect for the number of secondary branches per plant (0.2879) and the number of pods per plant (0.2284) on grain yield per plant, but a negligible positive direct effect for plant height (0.0148) and days to 50% flowering (0.0012). It had a moderate negative direct effect (- 0.2426) on the number of effective pods per plant and a negligible negative direct effect (-0.0867) on the number of primary branches per plant, seed index (-0.0064), and days to maturity (-0.0045)

Genotypic Level

Path analysis revealed a high positive direct effect for biological yield per plant (1.2145), Harvest Index (0.6589), and the number of pods per plant (0.2246) at the genotypic level, and a moderate positive direct effect for the number of secondary branches per plant (0.1891), Plant Height (0.0142), and the number of primary branches per plant (0.2246) at the genotypic level (0.0027). It had a moderately negative direct influence on the number of effective pods per plant (-0.3245), the Days to Maturity (-0.0599), the Seed Index (-0.0536), and the Days to 50% blooming (-0.0074).

Genetic Parameters For11biometrical Traits

Traits	DF50	DM	PH	NPBP	NSBP	NPP	NEPP	BYP	HI	SI	SYP
DF50	1.0000	0.3968**	0.0847	-0.2883*	0.1940	0.1134	0.1657	0.3701**	-0.3484**	-0.1200	0.1270
DM		1.0000	-0.0647	-0.2951*	0.2950*	0.1876	0.2192	0.4164***	-0.2852*	-0.2070	0.2449
PH			1.0000	0.2054	0.4085**	0.3149*	0.2734*	0.3241*	-0.0752	0.2260	0.348**
NPBP				1.0000	0.1205	-0.0455	-0.0973	-0.4487***	0.6748***	0.1028	0.0868
NSBP					1.0000	0.6160***	0.6192***	0.6983***	0.0031	0.1801	0.890**
NPP						1.0000	0.9811***	0.6082***	-0.1296	-0.2321	0.614**
NEPP							1.0000	0.6333***	-0.1535	-0.2663*	0.614**
BYP								1.0000	-0.5940***	0.0488	0.655**
HI									1.0000	0.0836	0.1930
SI										1.0000	0.1595
SYP											1.0000

of chickpea

Traits	GCV	PCV	h^2(bs)	GA	GAM
Daysto50%flowering	2.733	6.270	19.000	2.031	2.454
Daysto maturity	2.230	3.942	32.000	3.200	2.598
Plantheight(cm)	11.232	12.998	74.700	14.259	19.995
Numberofprimary branchesperplant	25.667	26.211	95.900	1.494	51.778
Numberofsecondary branchesperplant	27.190	27.663	96.600	2.176	55.056
Numberofpodsperplant	33.633	34.807	93.400	47.065	66.946
Numberofeffective podsperPlant	32.041	33.019	94.200	38.123	64.048
Biologicalyield perplant	28.247	30.387	86.400	19.637	54.091
Harvestindex(%)	14.987	20.666	52.600	11.023	22.389
SeedIndex(%)	26.043	26.936	93.500	9.957	51.870
Seedyield perpant (g)	23.192	26.210	78.300	7.286	42.274

Phenotypic Correlation among Different Traits in Chickpea

Genotypic Correlation among Different Traits in Chickpea

TRAITS	DF50	DM	PH	NPBP	NSBP	NPP	NEPP	BYP	HI	SI	SYP
DF50	1.0000	1.6298	0.0799	-0.726**	0.460**	0.290*	0.400**	0.833**	-0.721**	-0.292*	0.468**
DM		1.0000	-0.0215	-0.525**	0.426**	0.350**	0.407**	0.685**	-0.537**	-0.361**	0.451**
PH			1.0000	0.2177	0.475**	0.374**	0.328*	0.411**	-0.1058	0.2350	0.499**
NPBP				1.0000	0.1204	-0.0600	-0.1140	-0.500**	0.954**	0.0973	0.1054
NSBP					1.0000	0.651**	0.652**	0.764**	0.0460	0.1916	1.0496

							NPP	NEPP	BYP	HI	SI	SYP
NPP							1.0000	0.981**	0.632**	-0.1435	-0.2530	0.698**
NEPP								1.0000	0.662**	-0.1825	-0.287*	0.695**
BYP									1.0000	-0.675**	0.0621	0.795**
HI										1.0000	0.1251	-0.0937
SI											1.0000	0.2043
SYP												1.0000

TRAITS	DF50	DM	PH	NPBP	NSBP	NPP	NEPP	BYP	HI	SI
DF50	0.0012	0.0005	0.0001	-0.0004	0.0002	0.0001	0.0002	0.0005	-0.0004	-0.0001
DM	-0.0018	-0.0045	0.0003	0.0013	-0.0013	-0.0008	-0.0010	-0.0019	0.0013	0.0009
PH	0.0013	-0.0010	0.0148	0.0030	0.0060	0.0047	0.0040	0.0048	-0.0011	0.0033
NPBP	0.0250	0.0256	-0.0178	-0.0867	-0.0104	0.0039	0.0084	0.0389	-0.0585	-0.0089
NSBP	0.0559	0.0849	0.1176	0.0347	0.2879	0.1773	0.1783	0.2010	0.0009	0.0518
NPP	0.0259	0.0428	0.0719	-0.0104	0.1407	0.2284	0.2241	0.1389	-0.0296	-0.0530
NEPP	-0.0402	-0.0532	-0.0663	0.0236	-0.1502	-0.2380	-0.2426	-0.1536	0.0372	0.0646
BYP	0.3266	0.3675	0.2861	-0.3960	0.6163	0.5368	0.5590	0.8826	-0.5243	0.0430
HI	-0.2676	-0.2191	-0.0577	0.5182	0.0024	-0.0995	-0.1179	-0.4563	0.7680	0.0642
SI	0.0008	0.0013	-0.0014	-0.0007	-0.0012	0.0015	0.0017	-0.0003	-0.0005	-0.0064

Phenotypic Direct andindirecteffectsof11traitsongrain yieldinchickpea

DF50: Days to 50% Flowering, DM: Days to Maturity, PH: Plant Height, NPBP: Number of Primary Branches perPlant, NSBP: Number of Secondary Branches per Plant, NPP: Number of Pods per Plant, NEPP: Number of Effective PodsperPlant,BYP:BiologicalYieldperPlant,SI:SeedIndex,HI:HarvestIndex,SYP:SeedYieldperPlant

Genotypic path Direct (inbold) andindirecteffectsof11traitsongrain yieldinchickpea

TRAITS	DF50	DM	PH	NPBP	NSBP	NPP	NEPP	BYP	HI	SI
DF50	**-0.0074**	-0.0121	-0.0006	0.0054	-0.0034	-0.0022	-0.0030	-0.0062	0.0054	0.0022
DM	-0.0976	**-0.0599**	0.0013	0.0315	-0.0255	-0.0210	-0.0244	-0.0410	0.0322	0.0216
PH	0.0011	-0.0003	**0.0142**	0.0031	0.0067	0.0053	0.0047	0.0058	-0.0015	0.0033
NPBP	-0.0019	-0.0014	0.0006	**0.0027**	0.0003	-0.0002	-0.0003	-0.0013	0.0025	0.0003
NSBP	0.0869	0.0805	0.0899	0.0228	**0.1891**	0.1232	0.1233	0.1444	0.0087	0.0362
NPP	0.0650	0.0786	0.0840	-0.0135	0.1463	**0.2246**	0.2203	0.1419	-0.0322	-0.0568
NEPP	-0.1297	-0.1321	-0.1066	0.0370	-0.2116	-0.3182	**-0.3245**	-0.2148	0.0592	0.0932
BYP	1.0113	0.8320	0.4990	-0.6071	0.9275	0.7670	0.8037	**1.2145**	-0.8202	0.0754
HI	-0.4749	-0.3541	-0.0697	0.6288	0.0303	-0.0946	-0.1203	-0.4450	**0.6589**	0.0824
SI	0.0156	0.0193	-0.0126	-0.0052	0.0103	0.0135	0.0154	-0.0033	-0.0067	**-0.0536**

CONCLUSIONS

Based on the average performance of 20 chickpea genotypes, a conclusion has been reached. IPC-06127 [25.93] and ICC-15855 [22.26] genotypes had the maximum seed output per plant.

Significant differences were found for all of the seed yield and its components using Analysis of Variance, demonstrating that the genotypes have a lot of variabilities.

Number of major branches per plant, number of secondary branches per plant, number of pods per plant, number of effective pods per plant, biological yield per plant, seed index, and seed yield per plant had the maximum magnitude of GCV and PCV.

Number of major branches per plant, number of secondary branches per plant, number of pods per plant, number of effective pods per plant, biological yield per plant, seed index, and seed yield per plant all had strong heritability and genetic progress as percent of the mean.

Seed yield per plant had a highly significant positive correlation with biological yield per plant, number of pods per plant, number of effective pods per plant, and plant height at both the genotypic and phenotypic levels.

Biological yield per plant and harvest index had a substantial and favourable direct effect on seed yield per plant, according to path analysis. It suggests that there is a true link between these features and that direct selection for these traits will boost yield.

REFERENCES

1. Adhikari G, Pandey MP, (1982). Genetic variability in some quantitative characters on scope for improvement in chickpea (Cicer arietinumL.). Chickpea Newslett., June Icn., 7:4-5.

2. Anonymous (1995). Agricultural Statistics of Pakistan, Ministry of Food, Agriculture and Cooperatives,Islamabad.

3. Anonymous (2009). Economic Survey. Government of Pakistan, Finance Division, Economic Advisor's Wing Islamabad(2009-2010).

4. Arshad M, Bakhsh A, Bashir M, Haqqani AM (2002). Determining the heritability and relationship between yield and yield components in chickpea (Cicer arietinum L.). Pak. J. Bot., 34: 237-245.

5. Bhaduoria P, Chaturvedi SK, Awasthi NNC (2003). Character association and path coefficient analysis in chickpea (Cicer arietinum L.). Ann. Agric. Res., 24: 684-685.

6. Bicer BT, (2005). Evaluation of chickpea (Cicer arietinum L.) landraces. Pak. J. Biol. Sci., 8: 510-511.

7. Chavan VW, Path HS, Rasal PN (1994).Genetic variability, correlation studies and their implications in selection of high yielding genotypes of chickpea (Cicer arietinum L.). Madras Agric. J., 81:463-465.

8. Dasgupta T, Islam MO, Gayen (1992). Genetic variability and analysis of yield components in chickpea (Cicer arietinum L.). Ann. Agric. Res., 13:157-160.

9. Huisman J, Van der Poel AFB (1994). Aspects of the nutritional quality and use of cool season food legumes in animal feed, pp. 53-76.

10. Jeena AS, Arora PP (2001). Correlation between yield and its components in chickpea (Cicer arietinum L.). Legume Res., 24: 63- 64.

11. Kwon SH, Torrie JH (1964). Heritability and interrelationship of two soybean (Glycine max L.) populations. Crop Sci., 4: 196-198.

12. Mather K, Jinks JL (1982). The study of continuous variation. 3rd ed. London: Chapman and Hall; Biometrical genetics.

13. Muehlbauer FJ, Singh KB (1987). Genetics of chickpea (Cicer arietinum L.). In: M.C. Sexana and K.B. Singh (eds:), The chickpea CAB International, Wallingford, Oxon, OX10 8DE UK, p. 99-126.

14. Noor F, Ashaf M, Ghafoor A (2003). Path analysis and relationship among quantitative traits in chickpea (Cicer arietinum L.). Pak. J. Biol. Sci., 6: 551-555.

15. Obaidullah S, Munawar K, Iqbal A, Hamayun K (2006). Regression and correlation analysis in various cultivars of chickpea (Cicer arietinum L.). Ind. J. PI.Sci., 5: 551-555.

16. *Ozcelik H, Bozoglu H (2004). The determination of correlations between seed yield and some characters of chickpea (Cicer arietinum L.). Ondokuz Mays University, J. Fac. Zirrat, 19: 8-13 [CABB Abst.].*

17. *Raval LJ, Dobariya KL (2003). Yield components in improvement of chickpea (Cicer arietinum L.). Ann. Agric. Res., 24: 789-794.*

18. *Singh D, Sharma PC, Kumar R (1997). Correlation and path coefficient analysis in chickpea (Cicer arietinum L). Crop Res., 13: 625-629.*

19. *Steel RGD, Torrie JH (1997). Principles and procedures of statistics. McGraw Hill Book Co., NY. USA.*

20. *Wadud A, Yaqoob M (1989). Regression and correlation analysis in different cultivars of chickpea (Cicer arietinum L.). Sarhad J. Agric., 5:171-176.*

21. *Yadav NP, Sharma CH Haque MF (2001). Correlation and regression study of seed yield and its components in chickpea (Cicer arietinum L.). J. Res. Birsa Agric. Univ., 13: 149-151.*

22. *Muralidhara, Y. S., et al. "Studies on genetic variability, correlation and path analysis of seed yield and related traits in green gram [vigna radiata l. Wilczek]." International Journal of Agricultural Science and Research 5.3 (2015): 125-132.*

23. *Susmita, C., and B. Selvi. "Genetic variability for grain iron, zinc, other nutrients and yield related traits in sorghum (Sorghum bicolor (L.) Moench)." International Journal of Agricultural Science and Research (IJASR) 4.3 (2014): 91-99.*

24. *Dewangan, H. I. R. A. L. A. L., et al. "Study on genetic variability in groundnut (Arachis hypogaea L.) germplasms." Inter. J. Agric. Sci. Res 5.1 (2015): 19-22.*

25. *Hiralal, Dewangan, et al. "Study on genetic variability in groundnut (Arachis hypogaea L.) germplasm." International Journal of Agricultural Science and Research (IJASR) 5.1 (2015): 19-22.*

26. *Vikas, Kumar, et al. "Study on genetic variability, heritability and genetic advance for yield and yield attributing characters in cluster bean [Cyamopsis tetragonoloba (L.) Taub.]." International Journal of Agricultural Science and Research (IJASR) 5.4 (2015): 235-245.*